

## SPECIFICATION

### HARD TRAY FOR CARRYING SOCKET CONNECTORS

#### BACKGROUND OF THE INVENTION

##### 1. Field of the invention

**[0001]** The present invention relates to stackable hard trays used for storing and transporting goods, and more particularly to anti-suction means incorporated in a hard tray that stores integrated circuit (IC) sockets such as central processing unit (CPU) sockets each having a pick up cap mounted thereon.

##### 2. Description of the prior art

**[0002]** Hard trays are commonly used for carrying electrical socket connectors such as ball grid array (BGA) sockets. Automatic assembly lines are widely used in the mass production of connectors, and the hard trays are adapted to be easily handled and used on assembly lines.

**[0003]** FIGS. 5 and 6 show typical hard trays 5 for storing and transporting a plurality of BGA sockets 7 each having a pick up cap 6 mounted thereon. Four slots 70 are symmetrically defined in each BGA socket 7. Each pick up cap 6 has a rectangular base 60. A plane top surface 600 is formed on a top of the base 60, for facilitating engagement by a vacuum nozzle of an automatic vacuum suction device (not shown). Four protrusion blocks 62 extend from a bottom of the base 60, for respectively engaging in the slots 70 of a corresponding BGA socket 7. The pick up cap 6 is thereby mounted on the BGA socket 7.

**[0004]** A rectangular array of openings 50 is defined in each hard tray 5, the openings receiving corresponding BGA sockets 7 therein. Two pairs of extending portions 54 are formed in each opening 50, for supporting a corresponding BGA socket 7. A bottom portion 52 is defined in the opening 50 so as to prevent the hard tray 5 from generating thermal and stress warpage. Moreover, the bottom portion 52 protects soldering balls of the BGA socket 7 from being damaged or contaminated. A relatively smooth surface 520 is formed on a bottom of the bottom portion 52.

**[0005]** In storage, a plurality of hard trays 5 is stacked together as shown in FIG. 5, with a small gap between respective bottom portions 52 of two adjacent hard trays 5. Consequently, the bottom surfaces 520 of the bottom portions 52 of each hard tray 5 are relatively close to the top surfaces 600 of the pick up caps 6 mounted on the BGA socket 7 of an adjacent hard tray 5 therebelow.

**[0006]** In handling of each hard tray 5, an automatic carrier tool (not shown) grasps a topmost hard tray 5 in stack of the hard trays 5, and lifts the topmost hard tray 5 up and away from the stack. When the automatic carrier tool grasps the topmost hard tray 5, it generates a downward pressing force thereon. This pressing force is liable to enable the bottom surfaces 520 of the bottom portions 52 of the topmost hard tray 5 press on the top surfaces 600 of the corresponding pick up caps 6 mounted on the BGA socket 7 of the adjacent hard tray 5 therebelow. With each top surface 600 and each corresponding bottom surface 520 being relatively smooth, the top surface 600 and the bottom surface 520 are prone to engage with each other. During carriage of the topmost hard tray 5, the pick up caps 6 and the corresponding BGA sockets 7 of the adjacent hard tray 5 are liable to be sucked up and displaced or even taken away. The pick up caps 6 and the BGA sockets 7 taken away fall and are easily damaged. Even if the pick

up caps 6 and the BGA sockets 7 are not damaged, they need to be put back into the corresponding openings 50 of the adjacent lower hard tray 5. This results in inconvenience, delays, inefficiency, and increased costs.

[0007] What is needed is a new, improved hard tray for carrying socket connectors which overcomes the above-mentioned problems.

### SUMMARY OF THE INVENTION

[0008] Accordingly, a main object of the present invention is to provide a hard tray for carrying socket connectors each having a pick up cap mounted thereon, wherein the hard tray can be safely and efficiently stacked and carried.

[0009] To fulfill the above-mentioned object, the present invention apply stackable hard trays for carrying socket connectors each having a pick up cap mounted thereon. The pick up cap has a rectangular base with a plane top surface. Each hard tray has a rectangular bracket body. A rectangular array of openings is defined in the bracket body, for receiving corresponding socket connectors therein. First and second extending portions are formed in each opening, for supporting a corresponding socket connector therein. A bottom portion is formed in the opening. The bottom portion has a bottom surface rough enough to avoid sucking with a corresponding top surface of the pick up cap. Therefore, in carriage, the bottom surfaces of the bottom portions of one upper hard tray do not suck with the top surfaces of the corresponding pick up caps mounted on the socket connectors received in one adjacent lower hard tray. As a result, the hard trays are safely and efficiently stacked and carried

[0010] Other objects, advantages and novel features of the present invention

will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0011]** FIG. 1 is an isometric view of a hard tray according to the present invention, together with a BGA socket ready to be received in a corresponding opening of the hard tray, and a pick up cap ready to be mounted on the BGA socket;

**[0012]** FIG. 2 is an isometric view of a plurality of the hard trays of FIG. 1 stacked together, each hard tray being filled with BGA sockets each having a corresponding pick up cap mounted thereon;

**[0013]** FIG. 3 is a schematic, cross-sectional view of part of two adjacent hard trays and corresponding BGA sockets and pick up caps of FIG. 2, taken along line III-III thereof;

**[0014]** FIG. 4 is an enlarged view of a circled portion IV of FIG. 3;

**[0015]** FIG. 5 is an isometric view of a stack of conventional hard trays, each hard tray being filled with BGA sockets each having a corresponding pick up cap mounted thereon, showing one of the BGA sockets ready to be received in a corresponding opening of a topmost hard tray, and a pick up cap ready to be mounted on said BGA socket;

**[0016]** FIG. 6 is a schematic, cross-sectional view of part of two adjacent hard trays and corresponding BGA sockets and pick up caps of FIG. 5, taken

along line VI-VI thereof; and

**[0017]** FIG. 7 is an enlarged view of a circled portion VII of FIG. 6.

### DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

**[0018]** Reference will now be made to the drawings to describe the present invention in greater detail.

**[0019]** Referring first to FIG. 1, a hard tray 2 according to a preferred embodiment of the present invention is for carrying a plurality of IC sockets such as BGA sockets 4. A pick up cap 3 is mounted on each BGA socket 4, for facilitating carriage of the BGA socket 4 by an automatic vacuum suction device once the hard tray 2 has been delivered to a production line. The pick up cap 3 has a rectangular base 30. A plane top surface 300 is formed on a top of the base 30, for facilitating engagement by a vacuum nozzle of the vacuum suction device. Four protrusion blocks 32 depend from a bottom of the base 3. Four slots 40 are defined in the BGA socket 4, for engagingly receiving the protrusion blocks 32 of the pick up cap 3. Thus the pick up cap 3 is mounted on the BGA socket 4.

**[0020]** The hard tray 2 has a rectangular bracket body 23. A plurality of parallel first spacers 20 is transversely formed on the bracket body 23. A plurality of parallel second spacers 22 is longitudinally formed on the bracket body 23. The first and second spacers 20, 22 cooperatively define a matrix of rectangular openings 24 arranged in rows and columns, the openings 24 receiving corresponding BGA sockets 4 therein. A pair of ear portions 25 extends outwardly from opposite ends of the bracket body 23, for facilitating carriage of

the hard tray 2 by an automatic carrier tool (not shown). Four side walls 27 are formed around the bracket body 23, and four edges 28 are coplanarly defined on the side walls 27 respectively. The side walls 27 of any one hard tray 2 in a stack of the hard trays 2 stand on the corresponding edges 28 of an adjacent hard tray 2 below said one hard tray 2 in the stack (see FIG. 2).

**[0021]** Each opening 24 is defined between two adjacent two first spacers 20 and two adjacent second spacers 22, and dimensioned to accommodate the corresponding BGA socket 4 therein. A pair of first extending portions 200 extends from insides of the first spacers 20 into the opening 24. Each first extending portion 200 has a top surface 202. A pair of second extending portions 220 extends from insides of the second spacers 22 into the opening 24. Each second extending portion 220 has a top surface 222 coplanar with the top surfaces 202 of the first extending portions 200. The top surfaces 202, 222 of the first and second extending portions 200, 222 cooperatively support the BGA socket 4 in the opening 24.

**[0022]** The bracket body 23 defines a bottom portion 26 in each opening 24. The top surfaces 202, 222 of the first and second extending portions 200, 222 are higher than a top of the bottom portion 26. Thus, when a BGA socket 4 is received in the opening 24, the top of the bottom portion 26 does not touch soldering balls (not shown) of an underside of the BGA socket 4. Certain of the openings 24 at a middle of the bracket body 23 are fully closed off by the corresponding bottom portions 26. The remaining openings 24 at respective opposite ends of the bracket body 23 are only mostly closed off by the corresponding bottom portions 26. With this structure, thermal warpage of the bracket body 23 is effectively reduced.

**[0023]** Referring also to FIG. 4, each bottom portion 26 of the hard tray 2 has a bottom surface 260. The bottom surface 260 is roughened, so that the bottom portion 26 avoids sucking the top surface 300 of the pick up cap 3 of a corresponding BGA socket 4 received in an adjacent hard tray 2 below said hard tray 2.

**[0024]** Referring to FIG. 2, in storage, the pick up caps 3 are mounted on the corresponding BGA sockets 4, with the protrusion blocks 32 respectively engaging in the corresponding slots 40. The BGA sockets 4 are placed in the corresponding openings 24 of each hard tray 2, with the top surfaces 202, 222 of the first and second extending portions 200, 220 supporting the BGA sockets 4. Each hard tray 2 thus filled with BGA sockets 4 is placed on top of another hard tray 2 already filled with BGA sockets 4. The upper edges 28 of each hard tray 2 respectively support the side walls 27 of an adjacent hard tray 2 standing thereon. By this means, a plurality of the hard trays 2 is stacked together one on the other.

**[0025]** In order to efficiently create a stack of the hard trays 2, a gap between the respective bottom portions 26 of two adjacent hard trays 2 is relatively narrow, so that more hard trays 2 can be accommodated within a given height. As a result, the bottom surfaces 260 of the bottom portions 26 of each hard tray 2 are relatively close to the top surfaces 300 of the pick up caps 3 mounted on the BGA sockets of an adjacent hard tray 2 therebelow.

**[0026]** With this structure, in handling of each hard tray 2, the automatic carrier tool (not shown) grasps a topmost hard tray 2 in a stack of the hard trays 2, and lifts the topmost hard tray 2 up and away from the stack. When the automatic carrier tool grasps the topmost hard tray 2, it generates a downward

pressing force thereon. This pressing force presses the bottom surfaces 260 of the bottom portions 26 of the topmost hard tray 2 onto the corresponding top surfaces 300 of the pick up caps 3 of the adjacent hard tray 2 below the topmost hard tray 2. Nevertheless, because the bottom surfaces 260 are roughened, the top surfaces 300 are prevented from being sucked up with the bottom surfaces 260. Thus, when the topmost hard tray 2 is lifted away from the stack, the pick up caps 3 and the BGA sockets 4 of the adjacent hard tray 2 remain in their original positions. As a result, the hard trays 2 are safely and efficiently handled by the automatic carrier tool.

**[0027]** Although the present invention has been described with reference to the particular embodiment, it is not to be construed as being limited thereto. Various alterations and modifications can be made to the embodiment without in any way departing from the scope or spirit of the present invention as defined in the appended claims. For example, any means provided on the bottom surface 260 or/and the bottom portions 26, either projections or recesses/through openings to prevent suction between the bottom surface 260 and the pick up cap 3 of the neighboring connector thereunder is intended to be within the scope of the claims.